

Low-Energy Pelvic Ring Fractures in the Elderly Population: Expected Outcomes and Associated Mortality Rates

Michael Ghassibi^{a, c}, Dhanunjay Sarma Boyalakuntla^b, John Gentile^a

Abstract

Background: The aim of the study was to uncover mortality risk utilizing a retrospective review at a level I trauma center in addition to demographic factors.

Methods: Patients aged 65 and older with low-energy closed pelvic ring fractures treated non-operatively from 2007 to 2017 were queried from the level I trauma center database. Mortality rate and associated risks were calculated.

Results: The average age of all the patients included in this study who sustained a low-energy pelvic fracture was 83.1 years (± 7.5 ; 66 - 97). The mean length of stay was 4.6 days (± 4.4 ; 0 - 37). The mean number of comorbidities was 2.2. The 1-year mortality rate was 23%. The relative risk (RR) of 1-year mortality for low-energy pelvic fractures for ages 65+ did not statistically differ compared to the US population in 2016 (6.6%) (RR: 1.0; 95% CI). The 2+ comorbidities showed a statistical significance in the pelvic fracture population with a P value of 0.037. Race, sex, discharge disposition and length of stay did not reach statistical significance ($P > 0.05$).

Conclusion: Low-energy pelvic injuries do not appear to increase rate of mortality compared to the US population. Fracture pattern, race, sex, discharge disposition and length of stay do not seem to have an effect on mortality. Elderly patients with an average age of 84.5 years and more than two comorbidities had higher rates of mortality; however, these patients were likely to sustain earlier mortality regardless of low-energy pelvic fracture.

Keywords: Low-energy pelvic ring fractures; Elderly; Mortality rate

Introduction

Closed pelvic ring fractures have a major impact on the health-care system in terms of morbidity and mortality [1-5]. As the population in the United States continues to age, low-energy fractures of the pelvic ring will likely become more common. Studies have shown a significant increase in low-energy pelvic ring injuries in ages 60 and older [6-8]. Despite the increase in uniform management and improved understanding of low-energy injuries, information in terms of mortality and outcome is still limited [6]. Low-energy fractures of the elderly population sustained from a ground level fall frequently result in pelvic fractures that do not damage the true integrity of the ring structure and are often treated non-operatively. These fractures include superior and inferior pubic rami fractures as well as non-displaced sacral alar fractures.

The pelvic ring consists of the sacrum and the two innominate bones whose integrity is stabilized by the strong surrounding ligamentous structures. Pelvic fractures were classified in an attempt to facilitate injury identification and aid in prediction of associated injuries and prognosis [6]. The Young-Burgess classification system enables physicians to identify four types of ring disruption based on radiographic imaging for typically higher energy injuries. These four types consist of lateral compression, anterior posterior compression, vertical shear and combined mechanical injury [9]. Studies have shown that minimally displaced and stable high-energy injuries result in an acceptable long-term outcome, but no specific epidemiologic reports on mortality rate have been pursued in low-energy fractures in the elderly [10].

To our knowledge, there is a lack of literature specifically addressing the mortality of low-energy pelvic ring fractures. This study aimed to define the mortality and describe the population in general with a retrospective review. Additionally, the study intended to establish predicative factors for increased mortality after non-operative pelvic ring fractures to help guide resources for preventive measures to decrease the risk of a fall.

Materials and Methods

This was a retrospective chart review at a level I trauma center in Northeast Ohio. Electronic medical records of patients with low-energy closed pelvic ring fractures treated non-operatively from 2007 to 2017 were examined. Patients were included

Manuscript submitted May 29, 2019, accepted August 26, 2019

^aOrthopedic Surgery, Mercy Health St. Elizabeth Youngstown Hospital, 1044 Belmont Ave., Youngstown, OH 44501, USA

^bMercy Health St. Elizabeth Youngstown Hospital, 1044 Belmont Ave., Youngstown, OH 44501, USA

^cCorresponding Author: Michael Ghassibi, Orthopedic Surgery, Mercy Health St. Elizabeth Youngstown Hospital, 1044 Belmont Ave., Youngstown, OH 44501, USA. Email: gghassibi.mc@gmail.com

doi: <https://doi.org/10.14740/jocmr3891>

Table 1. Chi-Square Analysis

	Deceased	P
Race		
Caucasian	77 (47.8%)	0.518
Other	4 (66.7%)	
Sex		
Male	10 (55.6%)	0.49
Female	69 (46.9%)	
Discharge disposition		
Home/home health	16 (37.2%)	0.114
SNF/rehabilitation facility/LTAC	62 (51.2%)	
No. of comorbidities		
0-1	8 (21%)	0.037
2+	33 (26.6%)	

SNF: subacute nursing facility; LTAC: long-term acute care.

if they were ≥ 65 years old, sustained a closed pelvic ring fracture from a low-energy fall, the fracture did not warrant operative treatment and was stable based on clinical exam and radiographic assessment. Patients who underwent operative treatment for closed pelvic ring fracture, had a high-energy injury, or had previous closed pelvic ring injury were excluded. All patients who underwent non-operative treatment were allowed unrestricted weight bearing.

ICD-9 (808.2, 805.6, 808.42 and 808.44) and CPT (27193) codes were used to request data from the electronic medical records. Data on demographics (age, sex and race), date of injury, fracture pattern (closed pelvis without circle disruption, pubis, sacrum, coccyx and ischium), length of stay in days, discharge disposition (home, rehabilitation facility and subacute nursing facility) and comorbidities (diabetes mellitus, congestive heart, failure, cardiac arrhythmias, prior cerebrovascular accident, renal disease, cancer, Parkinson’s disease, hypertension, chronic obstructive pulmonary disease and the need for continued anticoagulation) were collected from the electronic medical records. Pelvis radiographs including computed tomography (CT) scan, when available, were examined by the first author (MG) as well as confirmed by the radiologist official impression.

The outcome measure was mortality using incidence of death, which was recorded by using three databases, which include the Ohio Department of Health vital statistics, the national death index and the social security death index.

Table 2. Logistic Regression Analysis

Independent variables	Mortality significance
Comorbidities (0-1; 2+)	0.037
Age	0.39
LOS	0.86
Discharge disposition (home, facility, death)	0.214

LOS: length of stay.

Statistical analysis

The Chi-square test was performed for each influencing variable to compare differences in proportions of variables in associated mortality of patients with P value ≤ 0.05 considered as significant. For those variables that showed most relation with mortality (comorbidities, age, length of stay and discharge disposition), logistic regression analysis was performed, with P value of < 0.05 considered significant. A sensitivity and specificity analysis of the variables was also performed. Patients in the study were age stratified to groups 65 - 84, 85 and older and overall ages 65 and older. Mortality rates at 1 year were calculated for each group. This was compared to the Center for Disease Control and Prevention National Center for Health Statistics 2016 National Vital Statistics Reports vol. 67 no. 5 Death Report [11]. Relative risk (RR), confidence interval (CI) and P values were calculated by Chi-square test using risk of fracture and death as variables.

Results

The mean age of all patients included in the study who sustained a low-energy pelvic fracture was 83.1 years (± 7.5; 66 - 97). The mean length of stay was 4.6 days (± 4.4; 0 - 37). The mean number of comorbidities was 2.2 (± 1.0; 0 - 3+).

The study population was comprised of 18 males (10.9%) and 147 females (89.1%). One hundred sixty-one patients were Caucasian (98.2%). Forty-three patients were discharged to home (26.1%) while the rest were discharged to either nursing homes or rehab centers; one patient died in hospital.

Chi-square analysis is shown in Table 1. The 2+ comorbidities showed a statistical significance in the pelvic fracture population with a P value of 0.037. Race, sex, discharge disposition and length of stay did not seem to have any effect on mortality.

Logistic regression analysis is shown in Table 2. It also shows that in all the independent variables, the number of comorbidities (more than 2) had a statistical significance on mortality (P = 0.037). Analysis of variance (ANOVA), as shown in Table 3, demonstrates a significance of age (mean age of patients who died is 84.5 years) and comorbidities (2.39) on mortality (P = 0.020).

The 1-year mortality for patients that sustained a low-energy pelvis fracture was 23.0% as seen in Table 4. The RR of 1-year mortality for low-energy pelvic fractures for ages 65+ did not reach statistical significance compared to the US population in 2016 (6.6%) (RR: 1.0; 95% CI). The RR of 1-year

Table 3. ANOVA

	Mortality	Mean	Standard deviation	P
Age	Dead	84.49	6.956	0.020
No. of comorbidities	Dead	2.39	1.062	0.020

ANOVA: analysis of variance.

mortality for low-energy pelvic fractures for ages 85+ (28.6%) did not differ compared to the US population (13.4%) (RR: 1.0; 95% CI). In the age group of 65 - 84, there was a statistical difference between mortality rate 18.2% and the standard US population of 3.1% with an RR of 5.6 (CI: 3.83 - 12.05, $P < 0.001$).

Discussion

The average age of the population that sustained a low-energy pelvic fracture from a ground level fall was 83 years. Advanced age has been associated with incidence of lower extremity fractures. The association could be attributed to multiple factors including increased frailty in the elderly population, decreased bone mineral content and an inability to tolerate necessary rehabilitation and lifestyle changes to prevent mechanical falls [12].

In this sample population, the overall mortality rate was 23% at 1 year. The RR did not differ from the United States mortality rate in 2016 of 65 years and older. Unlike hip fractures and unstable pelvic injuries, patients weight bear as tolerated immediately which has been shown to prevent deconditioning. Low-energy pelvic injuries do not require surgery, which decreases the risk of post-surgical complication that may cause early mortality [13].

Patients who sustained a low-energy pelvic fracture between the ages of 65 and 84 demonstrated a statistically significant mortality RR in the study compared to the cumulative 65+ age group. Perhaps a low-energy pelvic fracture is associated with an older physiologic age since the mean age of sustaining this fracture in the study was 83. There may be underlying factors that were not addressed in this study.

In the sampled population, length of stay, sex, discharge disposition and race did not have significant effect on mortality. This may be due to the inherent stability of these low-energy fractures allowing patients on average to mobilize and rehab earlier. Hip fractures require operative fixation which increases physiologic demands of the patient as well as potential for post-surgical complications. These findings contrast hip

fracture literature which show increased mortality of fractures in men and non-Caucasian patients [14-16].

The significance of comorbidity and its effect on post-fracture mortality has been well documented in orthopedic literature [16-18]. As expected, comorbidities are associated with higher risk of mortality regardless of the orthopedic injury. The mean age of the deceased patients was 84.5 years from the study. Elderly patients with an average of 84.5 years were found to have higher rates of mortality, but as described above, older ages are likely to sustain earlier mortality regardless of any contributing injury.

This study has several limitations. The study was retrospective in nature. The study yielded a population size of 165 and a smaller sample size could overestimate of mortality compared to a larger sample size. The patients were selected in a local region of northeast Ohio which may not reflect the heterogeneous national population. The study did not account for confounding factors associated with each comorbidity.

Low-energy pelvic injuries that did not require operative treatment did not increase patients' mortality rate compared to the United States population. To our knowledge, this is the first study published evaluating mortality and its risk factors for low-energy pelvic fractures in the elderly. Based on the results of this study, further investigation is warranted, including a larger sample population and multi-center study.

Acknowledgments

None to declare.

Financial Disclosure

None to declare.

Conflict of Interest

None to declare.

Table 4. Mortality Analysis

Age	Number of low-energy pelvic fractures	Mortalities at 1 year	Mortality rate	US mortality	Relative risk	95% CI	P value
65 - 84	88	16	18.2%	3.1%	5.8	3.83 - 12.05	< 0.001
85+	77	22	28.6%	13.4%	1.0	0.59 - 1.68	NS
65+	165	38	23%	6.6%	1.0	0.69 - 1.46	NS

CI: confidence interval.

Informed Consent

Not applicable.

Author Contributions

All authors have made substantial contributions to all of the following: 1) the conception and design of the study, or acquisition of data, or analysis and interpretation of data; 2) drafting the article or revising it critically for important intellectual content; and 3) final approval of the version to be submitted.

References

- Poole GV, Ward EF. Causes of mortality in patients with pelvic fractures. *Orthopedics*. 1994;17(8):691-696.
- Mucha P, Jr., Farnell MB. Analysis of pelvic fracture management. *J Trauma*. 1984;24(5):379-386.
- Poole GV, Ward EF, Griswold JA, Muakkassa FF, Hsu HS. Complications of pelvic fractures from blunt trauma. *Am Surg*. 1992;58(4):225-231.
- Pohlemann T, Gansslen A, Schellwald O, Culemann U, Tscherne H. Outcome after pelvic ring injuries. *Injury*. 1996;27(Suppl 2):B31-38.
- van Vugt AB, van Kampen A. An unstable pelvic ring. The killing fracture. *J Bone Joint Surg Br*. 2006;88(4):427-433.
- Rockwood CA, Green DP, Heckman JD, Bucholz RW. Chapter 45: Acetabulum Fractures. *Rockwood and Green's fractures in adults*. Philadelphia: Lippincott Williams & Wilkins. 2001.
- Ragnarsson B, Jacobsson B. Epidemiology of pelvic fractures in a Swedish county. *Acta Orthop Scand*. 1992;63(3):297-300.
- Luthje P, Nurmi I, Kataja M, Heliövaara M, Santavirta S. Incidence of pelvic fractures in Finland in 1988. *Acta Orthop Scand*. 1995;66(3):245-248.
- Burgess AR, Eastridge BJ, Young JW, Ellison TS, Ellison PS, Jr., Poka A, Bathon GH, et al. Pelvic ring disruptions: effective classification system and treatment protocols. *J Trauma*. 1990;30(7):848-856.
- Henderson RC. The long-term results of nonoperatively treated major pelvic disruptions. *J Orthop Trauma*. 1989;3(1):41-47.
- Kochanek KD, Murphy S, Xu J, Arias E. Mortality in the United States, 2016. *NCHS Data Brief*. 2017;293:1-8.
- Soderqvist A, Ekstrom W, Ponzer S, Pettersson H, Cederholm T, Dalen N, Hedstrom M, et al. Prediction of mortality in elderly patients with hip fractures: a two-year prospective study of 1,944 patients. *Gerontology*. 2009;55(5):496-504.
- Richmond J, Aharonoff GB, Zuckerman JD, Koval KJ. Mortality risk after hip fracture. *J Orthop Trauma*. 2003;17(1):53-56.
- Aharonoff GB, Koval KJ, Skovron ML, Zuckerman JD. Hip fractures in the elderly: predictors of one year mortality. *J Orthop Trauma*. 1997;11(3):162-165.
- Endo Y, Aharonoff GB, Zuckerman JD, Egol KA, Koval KJ. Gender differences in patients with hip fracture: a greater risk of morbidity and mortality in men. *J Orthop Trauma*. 2005;19(1):29-35.
- Penrod JD, Litke A, Hawkes WG, Magaziner J, Doucette JT, Koval KJ, Silberzweig SB, et al. The association of race, gender, and comorbidity with mortality and function after hip fracture. *J Gerontol A Biol Sci Med Sci*. 2008;63(8):867-872.
- Sexson SB, Lehner JT. Factors affecting hip fracture mortality. *J Orthop Trauma*. 1987;1(4):298-305.
- Schnell S, Friedman SM, Mendelson DA, Bingham KW, Kates SL. The 1-year mortality of patients treated in a hip fracture program for elders. *Geriatr Orthop Surg Rehabil*. 2010;1(1):6-14.